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| APPLICATION NO. | FILING DATE | FIRST NAMED INVENTOR | ATTORNEY DOCKET NO. | CONFIRMATION NO. |
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| 10/071,207 | 02/11/2002 | George Jonathan Kluth | 52352-785 | 9267 |

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| EXAMINER |
|---|
| GUERRERO, MARIA F |

| ART UNIT | PAPER NUMBER |
|---|---|
| 2822 | |

DATE MAILED: 09/25/2003

Please find below and/or attached an Office communication concerning this application or proceeding.

| Office Action Summary | Application No. | Applicant(s) | |
|---|---|---|---|
| | 10/071,207 | KLUTH ET AL. | |
| | Examiner | Art Unit | |
| | Maria Guerrero | 2822 | |

*-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --*

**Period for Reply**

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE *3* MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

**Status**

1)☒ Responsive to communication(s) filed on *30 June 2003* .

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

**Disposition of Claims**

4)☒ Claim(s) *1-20* is/are pending in the application.

4a) Of the above claim(s) *19 and 20* is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-18* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

**Application Papers**

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *07 June 2002* is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

11)☐ The proposed drawing correction filed on _____ is: a)☐ approved b)☐ disapproved by the Examiner.

If approved, corrected drawings are required in reply to this Office action.

12)☐ The oath or declaration is objected to by the Examiner.

**Priority under 35 U.S.C. §§ 119 and 120**

13)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____ .

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

14)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).

a) ☐ The translation of the foreign language provisional application has been received.

15)☒ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

**Attachment(s)**

1) ☐ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) _____ .
4) ☐ Interview Summary (PTO-413) Paper No(s). _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: .

## DETAILED ACTION

1. This Office Action is in response to the amendment filed June 30, 2003.

Claims 1-20 are pending.

### *Election/Restrictions*

2. Applicant's election of Group I claims 1-18 in Paper No. 8 is acknowledged. Because applicant did not distinctly and specifically point out the supposed errors in the restriction requirement, the election has been treated as an election without traverse (MPEP § 818.03(a)).

Claims 19-20 are withdrawn from further consideration pursuant to 37 CFR 1.142(b) as being drawn to a nonelected invention, there being no allowable generic or linking claim. Election was made **without** traverse in Paper No. 8.

### *Claim Rejections - 35 USC § 103*

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

3. Claims 1-3 and 5 are rejected under 35 U.S.C. 103(a) as being unpatentable over Bai (U.S. 5,889,331) in view of Applicant admitted prior art.

Bai teaches providing a semiconductor substrate (silicon) having an upper surface, a gate electrode formed on the upper surface of the substrate with a gate insulating layer therebetween, the gate electrode having an upper surface and source/

drain regions (Fig. 5-7, col. 3, lines 50-65, col. 5, lines 20-30, 40-45). Bai discloses forming source/drain extensions having a dopant concentration, forming metal silicide contacts on the upper surface of the gate electrode and the substrate in a manner sufficient to maintain the dopant concentration in the source/drain extensions (Fig. 7-9,col. 6, lines 15-20, 25-45).

In addition, Bai shows the temperature being below about 700°C throughout the forming of the metal silicide contacts (col. 6, lines 42-44). Bai discloses the metal silicide contacts being NiSi formed at a temperature of approximately 400-600°C (col. 6, lines 42-44). Bai teaches depositing a dielectric layer over the substrate and the gate electrode upper surfaces, patterning the dielectric layer to form sidewall spacers, depositing a nickel layer over the gate electrode, the substrate, and the sidewall spacers (Fig. 5-8, col. 5, lines 49-52). Bai discloses heating to react the nickel layer and form the nickel silicide (NiSi) contacts and removing the nickel that did not react to form the nickel silicide (Fig. 9, col. 6, lines 40-45).

Bai does not explicitly describe the dopant concentration as being supersaturated. However, Applicant admitted prior art teaches forming supersaturated dopant concentration on the extension to reduce the resistivity of the extensions (page1).

Therefore, it would have been obvious to a person of ordinary skill in the art at the time of the invention to recognize that the dopant concentration taught by Bai is supersaturated as taught Applicant admitted prior art. The modification would provide a method of forming reduced resistivity extensions while maintaining the thickness of the silicide layer (Bai, col. 2, lines 50-52).

4. Claim 4 is rejected under 35 U.S.C. 103(a) as being unpatentable over Bai (U.S. 5,889,331) and Applicant admitted prior art as applied to claims 1-3, 5 above, and further in view of Hsu (U.S. 5,491,099).

Regarding claim 4, the combination of Bai and Applicant admitted prior art does not specifically show removing the spacers prior to forming the source/drain extensions. However, Hsu teaches removing the spacers prior to forming the source/drain extensions and forming a second insulating layer to form second sidewall spacers (Fig. 4-9, col. 3, lines 25-45, 56-60, col. 4, lines 3-20).

Therefore, it would have been obvious to a person of ordinary skill in the art at the time of the invention to modify the combination of Bai and Applicant admitted prior art by including the conventional step of removing the spacers as taught Hsu in order to reduce risk of hot electron reliability failures (Hsu, col. 2, lines 1-2).

5. Claims 6-7 are rejected under 35 U.S.C. 103(a) as being unpatentable over Bai (U.S. 5,889,331) in view of Applicant admitted prior art as applied to claims 1-3, 5 above, and further in view of Murthy et al. (U.S. 6,235,568).

Regarding claims 6-7, the combination of Bai and Applicant admitted prior art does not specifically show the time and the concentration as claimed. However, Murthy et al. discloses the metal silicide contacts being NiSi formed at a temperature of 400°C to about 700°C for approximately 20-30 seconds (col. 9, lines 22-30, col. 9, lines 42-47). Murthy et al. teaches a dopant concentration being about $10^{21}$ ions/$cm^3$ by implanting a

dosage about 1x $10^{15}$-1x$10^{16}$ atoms/$cm^2$ and an energy of between 30-80 keV (col. 6, lines 20-30).

Therefore, it would have been obvious to a person of ordinary skill in the art at the time of the invention to modify the combination of Bai and Applicant admitted prior art by including the time and concentration taught by Murthy et al. in order to obtain the high dopant concentration taught by Bai. In addition, "where the general conditions of a claim are disclosed in the prior art, it is not inventive to discover the optimum or workable ranges by routine experimentation." In re Aller, 220 F.2d 454, 456, 105 USPQ 233, 235 (CCPA 1955).

6. Claims 8-9 are rejected under 35 U.S.C. 103(a) as being unpatentable over Bai (U.S. 5,889,331) in view of Applicant admitted prior art as applied to claims 1-3 and 5 above, and further in view of Tsukamoto (U.S. 5,399,506)

Regarding claims 8-9, the combination of Bai and Applicant admitted prior art does not specifically show exposing employing laser radiation with the specific energy as claimed. However, Tsukamoto shows employing laser radiation with an energy density ranging from 650 to 1100 nJ/cm2 (Abstract, col. 3, lines 1-5, col. 4, lines 30-35).

Therefore, it would have been obvious to a person of ordinary skill in the art at the time of the invention to modify the combination of Bai and Applicant admitted prior art by employing laser radiation as taught Tsukamoto in order to reduce leakage current (Tsukamoto, Abstract).

7. Claims 10-11 are rejected under 35 U.S.C. 103(a) as being unpatentable over Bai (U.S. 5,889,331) and Applicant admitted prior art as applied to claims 1-3, 5 above, and further in view of Ozturk et al. (U.S. 5,242847).

Regarding claims 10-11, the combination of Bai and Applicant admitted prior art does not specifically show forming the source/drain extensions by doped selective epitaxy by applying a gas mixture comprising SiH4, the temperature and pressure as claimed. However, Ozturk et al. teaches doping the substrate by selective epitaxy employing $SiH_4$, employing the temperature of about 500° C to about 800° C and the pressure of 2.5 torr (col. 6, lines 20-30, col. 7, lines 18-25).

Therefore, it would have been obvious to a person of ordinary skill in the art at the time of the invention to modify the combination of Bai and Applicant admitted prior art by including the teaching of Ozturk et al. in order to form shallow doped regions (Ozturk et al., col. 3, lines 35-45).

8. Claims 12-13 are rejected under 35 U.S.C. 103(a) as being unpatentable over Bai (U.S. 5,889,331) in view of Applicant admitted prior art and Hsu (U.S. 5,491,099).

Bai teaches providing a semiconductor substrate (silicon) having an upper surface, a gate electrode formed on the upper surface of the substrate with a gate insulating layer therebetween, the gate electrode having an upper surface and source/ drain regions (Fig. 5-7, col. 3, lines 50-65, col. 5, lines 20-30, 40-45). Bai discloses forming source/drain extensions having a dopant concentration, forming metal silicide contacts on the upper surface of the gate electrode and the substrate in a manner

sufficient to maintain the dopant concentration in the source/drain extensions (Fig. 7-9,col. 6, lines 15-20, 25-45).

In addition, Bai shows the temperature being below about 700°C throughout the forming of the metal silicide contacts (col. 6, lines 42-44). Bai discloses the metal silicide contacts being NiSi formed at a temperature of approximately 400-600°C (col. 6, lines 42-44). Bai teaches depositing a dielectric layer over the substrate and the gate electrode upper surfaces, patterning the dielectric layer to form sidewall spacers, depositing a nickel layer over the gate electrode, the substrate, and the sidewall spacers (Fig. 5-8, col. 5, lines 49-52). Bai discloses heating to react the nickel layer and form the nickel silicide (NiSi) contacts and removing the nickel that din not react to form the nickel silicide (Fig. 9, col. 6, lines 40-45).

Bai does not explicitly describe the dopant concentration as being supersaturated. However, Applicant admitted prior art teaches forming supersaturated dopant concentration on the extension to reduce the resistivity of the extensions (page1).

Bai does not specifically show removing the spacers prior to forming the source/drain extensions. However, Hsu teaches removing the spacers prior to forming the source/drain extensions and forming a second insulating layer to form second sidewall spacers (Fig. 4-9, col. 3, lines 25-45, 56-60, col. 4, lines 3-20).

Therefore, it would have been obvious to a person of ordinary skill in the art at the time of the invention to recognize that the dopant concentration taught by Bai is supersaturated as taught Applicant admitted prior art and to include the conventional

step of removing the spacers as taught Hsu. The modification would provide a method of forming reduced resistivity extensions while maintaining the thickness of the silicide layer (Bai, col. 2, lines 50-52) and reducing the risk of hot electron reliability failures (Hsu, col. 2, lines 1-2).

9. Claims 14-15 are rejected under 35 U.S.C. 103(a) as being unpatentable over Bai (U.S. 5,889,331), Applicant admitted prior art, and Hsu (U.S. 5,491,099) as applied to claims 12-13 above, and further in view of Ozturk et al. (U.S. 5,242847).

Regarding claims 14-15, the combination of Bai, Applicant admitted prior art. and Hsu does not specifically show forming the source/drain extensions by doped selective epitaxy by applying a gas mixture comprising $SiH_4$, the temperature and pressure as claimed. However, Ozturk et al. teaches doping the substrate by selective epitaxy employing $SiH_4$, employing the temperature of about 500° C to about 800° C and the pressure of 2.5 torr (col. 6, lines 20-30, col. 7, lines 18-25).

Therefore, it would have been obvious to a person of ordinary skill in the art at the time of the invention to modify the combination of Bai; Applicant admitted prior art, and Hsu by including the teaching of Ozturk et al. in order to form shallow doped regions (Ozturk et al., col. 3, lines 35-45).

10. Claims 16-17 are rejected under 35 U.S.C. 103(a) as being unpatentable over Bai (U.S. 5,889,331), Applicant admitted prior art, and Hsu (U.S. 5,491,099) as applied to claims 12-13 above, and further in view of Tsukamoto (U.S. 5,399,506).

Regarding claims 16-17, the combination of Bai, Applicant admitted prior art, and Hsu does not specifically show exposing employing laser radiation with the specific energy as claimed. However, Tsukamoto shows employing laser radiation with an energy density ranging from 650 to 1100 $nJ/cm^2$ (Abstract, col. 3, lines 1-5, col. 4, lines 30-35).

Therefore, it would have been obvious to a person of ordinary skill in the art at the time of the invention to modify the combination of Bai, Applicant admitted prior art, and Hsu by employing laser radiation as taught Tsukamoto in order to reduce leakage current (Tsukamoto, Abstract).

11. Claim 18 is rejected under 35 U.S.C. 103(a) as being unpatentable over Bai (U.S. 5,889,331), Applicant admitted prior art, and Hsu (U.S. 5,491,099) as applied to claims 12-13 above, and further in view of Murthy et al. (U.S. 6,235,568).

Regarding claim 18, the combination of Bai, Applicant admitted prior art, and Hsu does not specifically show the dopant concentration being about $10^{21}$ $ions/cm^3$. However, Murthy et al. teaches the concentration being $10^{21}$ $ions/cm^3$ (col. 1, lines 60-65, col. 3, lines 40-46, col. 5, lines 10-15, col. 6, lines 20-30).

Therefore, it would have been obvious to a person of ordinary skill in the art at the time of the invention to modify the combination of Bai, Applicant admitted prior art, and Hsu by specifying by including concentration taught by Murthy et al. in order to obtain the high dopant concentration taught by Bai. In addition, "where the general conditions of a claim are disclosed in the prior art, it is not inventive to discover the

optimum or workable ranges by routine experimentation." In re Aller, 220 F.2d 454, 456, 105 USPQ 233, 235 (CCPA 1955).

***Conclusion***

12. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Maria Guerrero whose telephone number is 703-305-0162.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Amir Zarabian can be reached on 703-308-4905. The fax phone numbers for the organization where this application or proceeding is assigned are 703-308-7722 for regular communications and 703-308-7724 for After Final communications.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is 703-308-0956.

María Guerrero
Maria Guerrero
Patent examiner
September 22, 2003